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Peacekeeping: a Strategic Approach

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Abstract:
This paper presents a theoretical model of conflict between two players, with intervention by a peacekeeping force. Peacekeepers are treated as a military contingent, capable of taking sides, acting as a third (independent) side in the war, or remaining inactive, depending on circumstances. This departs from previous models, in which peacekeeping was no more than a parameter affecting players' fighting costs. The main result is an optimal deployment strategy by peacekeepers, detailing the nature and level of intervention required under different circumstances; a strategy which results in the lowest possible level of warfare between the two antagonists. The credible threat of force (rather than mere intervention) is the strategy's key component.

Keywords: Peacekeeping, conflict, responsibility to protect (R2P).

JEL classification: D74, F53, H56.

1 Introduction

United Nations peacekeeping missions have existed since 1948.[1] Over the years there have been close to seventy, of which sixteen are still currently active at the time of writing. Most of those who have examined the UN's peacekeeping record recognize that although some of these missions have succeeded in bringing peace to conflict areas, many others have failed (Durch, 1996; Diehl, 2008; Evans, 2008; to name just a few).

During this time, the nature of war, and therefore the demands made on peacekeepers, changed. As Dallaire (2003) writes:

> During the Cold War, peacekeeping missions generally monitored the implementation of peace agreements and prevented isolated incidents from leading to a resumption of conflict. In the nineties the focus shifted: the mission aim was to bring about a form of order, whether it be a system of humanitarian relief or an agreement forced on warring factions.

But despite this change the guiding principles of UN peacekeeping missions have remained the same: only intervene if all parties agree; remain impartial; and only use force for self-defence. These principles are often seen as limitations of peacekeeping missions, perhaps the reason for the failure of some of them.

UN field commanders have complained of the crippling restrictions of their mandates (Mackenzie, 1993; Dallaire, 2003). After his tour in Sarajevo, Mackenzie was asked what could be done about Bosnia. His reply was, "Stop the war. But you can't do that militarily without killing a lot of people, including your own."

In this paper I imagine a peacekeeping force which has complete leeway as to its mode of intervention. It can fight on one side of the conflict against the other; it can fight both sides at once; it can simply stand aside. If given such latitude, what would be the optimal strategy for such a force if its goal is to reduce the intensity of the conflict, as measured by the combined levels of armament by both adversaries?

Peacekeepers in the model have the advantage of being able to size up the forces of the two adversaries in the conflict before going into combat themselves, and the disadvantage of limited resources. Under these conditions, I consider two fairly intuitive strategies that might come to mind. The first is *full deployment*, in which the peacekeeping force enters the conflict as a third side in an effort to deter the others. This is shown to be effective only when the peacekeeping force is very large. The second is referred to as *underdog deployment* and consists of fighting on the weaker side, no matter what the sizes of the two armies are. This strategy has ambiguous results, as no pure-strategy equilibrium exists in the ensuing conflict situation between the two adversaries.

[1] The term *peacekeeping* is used here in the colloquial sense of any third-party force sent to a conflict area with the aim of reducing the intensity of warfare. Strictly speaking, the term *peace operations* is more appropriate, but less recognizable to most audiences. For a taxonomy of the various kinds of peace operations (of which traditional peacekeeping is one) see Diehl (2008).

I consider a third strategy, called *strategic deployment*, which is a variant of the second, but requires a minimum level of armament by at least one side in the conflict before peacekeepers are actually called into play. In terms of reducing the intensity of the conflict (i.e. the combined levels of armament on both sides) this strategy is optimal. Not only does it perform better than the previous two, it performs better than any other strategy one could conceive of, as is mathematically shown.

Strategic deployment has the added advantage that it is agreeable to the adversaries themselves. Indeed, their payoffs under strategic deployment are higher than under any other mode of intervention. This occurs because strategic deployment prevents them from devoting too many resources to the conflict, which is an essentially wasteful activity.

In strategic deployment, it is the *threat* of intervention which makes the adversaries conduct themselves in the manner desired. In equilibrium, the peacekeepers do not actually fight. This is, of course, another decided advantage of this strategy.

Strategies are predicated on the peacekeeping force announcing, before any conflict begins, how it will react when a conflict does arise. The announcement must be heard and believed by all potential belligerents. Thus the announcement must be a credible commitment.[2] So under strategic deployment, even though peacekeepers do not actually fight in equilibrium, they must be prepared to fight if one of the adversaries deviates from his equilibrium behavior. This will ensure that the peacekeeping authority's credibility is maintained for future conflict situations.

1.1 Related literature

Regan (1996) conducted an empirical study of third-party interventions, and arrived at the conclusion that some combination of military and economic policies achieves best results. He does not present a theoretical model, but does provide a suggestion to theorists interested in the topic: "The key to any intervention strategy is to alter the calculations by which the antagonists arrive at particular outcomes."

Siqueira (2003) provides a simple conflict model in which a third party is capable of altering the combatants' cost parameters; that is to say, the third party can make it more or less expensive for combatants to wage war. But since combatants simply take these parameters as given, there is in fact very little by way of strategic interaction between combatants and the third party.

In Chang, Potter and Sanders (2007), the third party is an ally of one of the combatants. It makes a money transfer to the side it favors, and it does this prior to the conflict. The two sides in the conflict take this behavior as given, as in Siqueira (2003); to them it is simply a matter of the parameters having changed.

[2]This issue of credible commitment is resolved by imagining that the conflict is one of a series of conflicts (or potential conflicts) spread out over an infinite time-horizon. Then, as is well known from the literature on infinitely-repeated games, the peacekeeping authority has an incentive to honor its commitments, i.e. make good on its promises and threats, if it is to be believed in the future.

In these two papers, the third party's actions are *not* contingent on the actions taken by the combatants. This allows the two sides in the conflict to "go all out," in a sense: their parameters may have been influenced by the third party, but they do not fear any *future* consequences of their actions. They are the last players to move.

In Gershenson (2002), by contrast, the third party imposes a sanction on the winner of the conflict, thereby reducing the incentive to win. This is of course an economic measure, and not a military one.

Amegashie and Kutsoati (2007) actually allow the third party (in one part of the paper) to intervene as a combatant. It chooses its level of effort at the same time as the belligerents choose theirs. This has interesting effects: in equilibrium, we may see one (but not both) of the original warring factions lay down its arms, if it is comparatively week. However, the third party is always a third combatant, i.e. never takes sides, as it does in this model.

See Solomon (2007) for a review of some of the earlier literature on the topic.

2 The model

The context of the model is a civil conflict opposing two groups. For simplicity, the decision-maker at the head of each group will be called a *warlord*. Both warlords attach the same value R to victory; this can be land, power, a resource, or all of these. Each warlord's problem is to decide on the level of force to deploy in the conflict, knowing that force is costly. Here force can mean a level of effort or a number of soldiers or guns. At any rate it will be represented by a single number G_i for each warlord: warlord 1 chooses G_1 and warlord 2 chooses G_2.

A standard way of modeling the outcome of such a conflict is to use a *contest success function*. I will use its simplest form, according to which warlord i's probability of victory (or his share of the prize) is

$$P_i = \frac{G_i}{G_1 + G_2} \quad , \tag{1}$$

assuming the two warlords' forces are the only ones to take the field. If $G_1 = G_2 = 0$, it is assumed that $P_1 = P_2 = 1/2$. That is to say, if peace prevails, the outcome is a draw. Contest success functions were pioneered by Tullock (1980) and further analysed by Hirshleifer (1988, 1991); see Garfinkel and Skaperdas (2007) for an overview of the several variations commonly used.[3]

The warlord's expected gain is $P_i R$. From this one must subtract his costs $C_i(G_i)$. His payoff is therefore

[3]For example, parameters could be added to the form above to create an asymmetry in the conflict: thus even if $G_1 = G_2$, one side would have a greater chance than the other of winning. This might be the case if an established government is fighting a rebel group. The present model could be adapted for this case; calculations would be more involved, but the qualitative nature of the results would be unchanged.

$$\pi_i \quad = \quad P_i R - C_i(G_i) \quad . \tag{2}$$

This is what each warlord tries to maximize. An equilibrium is found when G_1 maximizes π_1 taking G_2 as given and, simultaneously, G_2 maximizes π_2 taking G_1 as given.

In this model, the simple (and fairly standard) unit-cost form will be used:

$$C_i(G_i) = G_i \quad . \tag{3}$$

It has no parameters which can be manipulated by peacekeepers.

Peacekeepers will act as an *additional* military force, fighting either on warlord 1's side, on warlord 2's side, or as an adversary to both. I will call G_1^P any peacekeeping force deployed to assist warlord 1, G_2^P any that assists warlord 2, and G_3^P any that acts independently and fights both warlords at the same time. Of the three quantities G_1^P, G_2^P and G_3^P, at most one can be positive; the other two must be zero, otherwise peacekeepers would be fighting each other.[4] Possibly all three will be zero, if peacekeepers choose not to participate in the conflict.

The deployment of peacekeepers affects the contest success function. Now warlord i's probability of winning is

$$P_i \quad = \quad \frac{G_i + G_i^P}{G_1 + G_2 + G^P} \quad , \tag{4}$$

where $G^P \equiv G_1^P + G_2^P + G_3^P$. Again, in the absence of any military strength (all the Gs equal to 0), a draw is assumed ($P_1 = P_2 = 1/2$).

Technically equation (4) implies that the peacekeepers also have a probability of winning the conflict. This idea will not be dealt with formally: the peacekeeping objective is not to win, but to make it harder for the others to win, and so compel them to fight less. Although there is no accepted measure of the intensity of conflict, it will be adequate here to say that the third party's goal is to minimize $G_1 + G_2$.

When sending peacekeeping forces to combat zones, third parties often have limited resources at their command. For this reason I assume there is an upper bound K to the force G^P which can be mobilized. Another possible interpretation of K is that it is the size of a mission sent to a conflict area but not deployed right away. Peacekeepers then decide which part of the K troops at their disposal to engage in combat under what circumstances.

The choice of G^P and its fighting orientation (i.e. whether it fights on one side or acts independently) is made after observing G_1 and G_2. This is the the third party's *rule of engagement* (ROE), and is announced at the beginning of the game. Mathematically a rule of engagement is a function $h : \mathbb{R}^2 \rightarrow \mathbb{R}^3$ which takes

[4]This is just common sense. The assumption is not mathematically necessary for the results.

as arguments the warlords' choices (G_1, G_2) and returns the third party's choice (G_1^P, G_2^P, G_3^P).

The precise timing of the game is as follows:

1. the third party announces its ROE;
2. the warlords choose their forces (G_1 and G_2);
3. the third party deploys (G_1^P, G_2^P, G_3^P) according to the ROE announced earlier;
4. war is waged.

In this context an equilibrium is defined as a pair (G_1^*, G_2^*) and an ROE such that each warlord's choice of G_i^* maximizes his payoff given the other warlord's choice and the ROE; while the ROE is the rule which minimizes $G_1^* + G_2^*$.

For the sake of time-consistency, I assume that peacekeepers, once their ROE is announced, are committed to enforcing it. That is, they do not announce one ROE, then change their minds about it once the two warlords have chosen G_1 and G_2. This is certainly justifiable if we take a long-term view, in which the situation described in this model occurs again and again. When a game is repeated indefinitely, players who want to be believed in the future must honor their promises in the present. Although I do not model this explicitly, I have in mind a situation where peacekeepers do value their future credibility enough to warrant this behavior.

In what follows, I will examine the model's equilibrium properties under three different ROEs. The first ROE is what I call *full deployment*, in which the entire peacekeeping mission K is deployed as an independent force (i.e. not affiliated with either side) whenever hostilities take place. In the second ROE, which I call *underdog deployment*, peacekeepers help the weaker adversary, i.e. the one who has chosen the lower armed strength, whenever there are hostilities. The third ROE is a variation of the second, with the qualification that no peacekeepers are deployed if both G_1 and G_2 are sufficiently low. I will show that the third ROE, which I call *strategic deployment*, is optimal in inducing warlords to keep hostilities to a minimum.

2.1 Full deployment

Under full deployment, the entire force K is sent into combat as a third contender whenever either warlord arms himself:[5]

$$(G_1^P, G_2^P, G_3^P) = \begin{cases} (0,0,0) & \text{if} \quad G_1 = G_2 = 0 \quad ; \\ (0,0,K) & \text{otherwise.} \end{cases} \tag{5}$$

Each warlord chooses G_i to maximize

[5] It seems natural to set $G^P = 0$ whenever $G_1 = G_2 = 0$ in *any* rule of engagement. First, the idea of keeping the peace (i.e. $G^P > 0$) when no hostilities are imminent is awkward. Second, it makes possible $P_1 = P_2 = 1/2$ in a context of peace.

$$\pi_i \quad = \quad \left[\frac{G_i}{G_1 + G_2 + K}\right] R - G_i \quad , \tag{6}$$

taking the other warlord's strength as given. Optimality conditions are found by taking the derivatives $\partial\pi_1/\partial G_1$ and $\partial\pi_2/\partial G_2$ and setting them to zero. Solving these conditions then yields the solution

$$G_1 \quad = \quad G_2 \quad = \quad \frac{R - 4K + \sqrt{R^2 + 8KR}}{8} \quad \equiv \quad G^F \quad . \tag{7}$$

This is the equilibrium as long as G^F is not negative, which means as long as $K \leq R$. If $K > R$ then peace, i.e. $G_1 = G_2 = 0$, is the equilibrium. Note that $K > R$ is a massive force, probably quite unrealistic.

However, there is a range of values of K for which two equilibria exist, one of which is peace. The minimum level of K which allows (rather than ensures) a peaceful equilibrium is found as follows. Suppose $G_2 = 0$. Warlord 1, if he also chooses $G_1 = 0$, can get a payoff of $R/2$: this is the payoff of peace. If, however, he decides to arm himself, he will face a peacekeeping force of K and his payoff will be

$$\pi_1 \quad = \quad \left[\frac{G_1}{G_1 + K}\right] R - G_1 \quad . \tag{8}$$

The maximum this can be is $\pi_1 = R + K - 2\sqrt{KR}$; this can be found by straightforward optimization. As long as this is less than or equal to $R/2$, then $G_1 = 0$ is optimal for warlord 1. That requires

$$K \geq \alpha R \quad , \tag{9}$$

where $\alpha \equiv (1 - \sqrt{2}/2)^2$. The same logic applies to warlord 2; therefore if (9) holds, $G_1 = G_2 = 0$ is an equilibrium.

So when $\alpha R \leq K < R$, there are two equilbria: $G_1 = G_2 = G^F$ is one and $G_1 = G_2 = 0$ is the other. If one warlord has strength G^F, it is optimal for the other to acquire the same strength; but if one is unarmed, then remaining unarmed is optimal for the other.[6] The situation is illustrated in Figure 1. The graph shows equilibrium values of G_1 and G_2 for various levels of K. The downward-sloping curve shows equilibria where $G_1 = G_2 = G^F$, as given by equation (7). We can see that for any $K > 0$ the level of armament chosen by each warlord is less than $R/4$, the level chosen when there is no intervention. The thick line segment along the horizontal axis shows the peaceful equilibria, where $G_1 = G_2 = 0$.

If there were no limit on K, the size of a peacekeeping force to be sent to a conflict area, then there would be no problem maintaining peace. But third parties may not

[6] When $K = R$, both are equivalent, since $G^F = 0$.

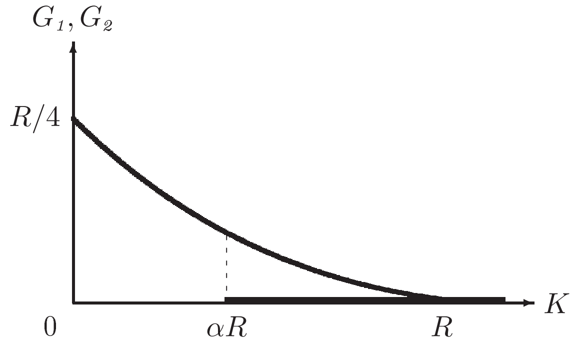

FIGURE 1. Equilibria under full deployment. When $\alpha R \leq K < R$, two equilibria exist, one of which is peace.

have enough money to finance large-scale operations, or they may not have enough soldiers. Sometimes there are several areas experiencing conflict concurrently, each one a worthy candidate for involvement. The question arises, then, how best to use a limited force, a relatively small level of K. Is there a way to obtain better results than those of full deployment?

2.2 Underdog deployment

One possibility is to come to the assistance of whichever side has chosen the lower level of armament, if one is indeed lower than the other. The plan might be

$$(G_1^P, G_2^P, G_3^P) = \begin{cases} (K,0,0) & \text{if} \quad G_2 > G_1 \quad ; \\ (0,K,0) & \text{if} \quad G_1 > G_2 \quad ; \\ (0,0,0) & \text{if} \quad G_1 = G_2 \quad . \end{cases} \tag{10}$$

With such a plan, the payoff functions π_1 and π_2 have a discontinuity at $G_1 = G_2$; finding equilibrium choices is less straightforward.

If K is large enough, then this plan is quite successful, as then $G_1 = G_2 = 0$ in equilibrium. To see that this is an equilibrium, suppose that warlord 2 chooses $G_2 = 0$. If warlord 1 chooses $G_2 = 0$ he will get $R/2$. If instead he chooses $G_1 > 0$ he must fight all K peacekeepers; his maximum payoff in that case can be calculated as $\pi = R + K - 2\sqrt{KR}$, just as under the full-deployment ROE. As long as $K \geq \alpha R$, choosing $G_1 = 0$ yields the higher payoff. The same argument holds for warlord 2.

If $K < \alpha R$, however, the peaceful situation $G_1 = G_2 = 0$ cannot be sustained as an equilibrium under this ROE. At least one warlord would have an incentive to raise an army. In fact there is *no* pure-strategy equilibrium in this case. I will not show this formally, but only give an outline of the reasoning. Essentially, any situation $G_1 = G_2 > 0$ fails as an equilibrium, since each warlord would wish to decrease his army slightly in order to attract all peacekeepers to his side. An asymmetric situation $G_1 < G_2$ also fails as an equilibirum: either warlord 1 would want to increase G_1 or warlord 2 would want to decrease G_2, or both. Similarly, $G_2 < G_1$ will not work.

If $K < \alpha R$, a mixed-strategy equilibrium may exist. This would have the drawback that G_1 and G_2 could not be predicted by anyone with certainty. The main result, which follows presently, is an ROE which always yields a pure-strategy equilibrium, and which guarantees minimal recruitment: no other plan produces a lower value of $G_1 + G_2$.

2.3 Strategic deployment: the optimal plan

Under strategic deployment, the third party sets a limit M on G_1 and G_2. If either warlord gains an advantage over the other by exceeding this limit, the third party commits all its troops to assist the weaker side; if neither warlord exceeds the limit, or if the two are equally matched, the third party stays out of the conflict. Hence

$$(G_1^P, G_2^P, G_3^P) \quad = \quad \begin{cases} (K,0,0) & \text{if} \quad G_2 > \max\{G_1, M\} \quad ; \\ (0,K,0) & \text{if} \quad G_1 > \max\{G_2, M\} \quad ; \\ (0,0,0) & \text{otherwise;} \end{cases} \tag{11}$$

$$\text{where} \qquad M \equiv \max\left\{ 0 \ , \ \frac{R - 2K - 2\sqrt{2KR}}{4} \right\} \quad . \tag{12}$$

Note that $M = 0$ when $K \geq \alpha R$, where α was defined right after equation (9).

This plan is illustrated in Figure 2. It is designed to induce the warlords to choose $G_1 = G_2 = M$, which they do in equilibrium, as will be shown. Total recruitment in equilibrium is therefore $G_1 + G_2 = 2M$. Warlords' combined payoffs are $\pi_1 + \pi_2 = R - 2M$. In Propositions 2 and 3 we show that no equilibrium has a smaller value of $G_1 + G_2$ or higher combined payoffs for the warlords.

The quantity M is constructed as the smallest military strength which makes the warlords willing to conform to such a plan. If it were any smaller, one of the warlords would want to deviate by choosing a level of strength well above M, even though this would result in the deployment of all K peacekeeping troops against him.

Let us see first of all why $G_1 = G_2 = M$ is an equilibrium when the ROE is given by (11) and (12). Suppose warlord 2 sets $G_2 = M$. If warlord 1 does the same, his payoff will be $R/2 - M$. Can this be improved upon? If he chooses $G_1 < M$ his payoff will be

$$\pi_1 \quad = \quad \left[\frac{G_1}{G_1 + M} \right] R - G_1 \quad . \tag{13}$$

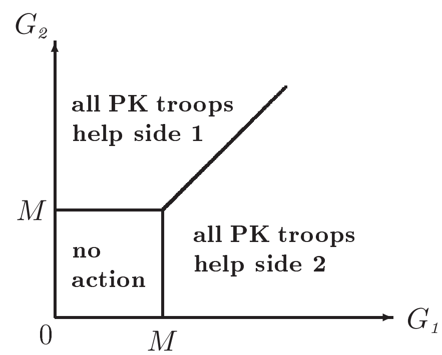

FIGURE 2. Strategic deployment. The third party helps one side or the other, or neither, depending on G_1 and G_2. PK stands for peacekeeping.

This is increasing in G_1 from 0 all the way to M, so no level in this range can do better than $G_1 = M$. If he chooses $G_1 > M$, his payoff will be

$$\pi_1 \quad = \quad \left[\frac{G_1 + M}{G_1 + M + K}\right] R - G_1 \quad . \tag{14}$$

This is concave in G_1, and reaches a maximum at $G_1 = \sqrt{(K+M)R} - (K+M)$. If $K \leq \alpha R$, the payoff for that level of G_1 is equal to $R/2 - M$, the same as he gets by choosing $G_1 = M$; if $K > \alpha R$, it is less. Therefore $G_1 = M$ is optimal. And since the same logic can be used for warlord 2, we may conclude that $G_1 = M$ and $G_2 = M$ are mutually optimal under this ROE.

Moreover, there are no other equilibria under this ROE. This is formalized as

Proposition 1. *Under strategic deployment, the only equilibrium is $G_1 = G_2 = M$.*

Proof. See appendix.

Figure 3 shows equilibrium values of G_1 and G_2 for different levels of K; in all equilibria $G_1 = G_2$. The thick curve shows equilibria under strategic deployment. Along the downward-sloping part we have $G_1 = G_2 = M$; the flat part shows peaceful equilibria. The thin curve is reproduced from the full-deployment diagram for comparison. We can see that strategic deployment performs better than full deployment when $0 < K < \alpha R$. When $\alpha R \leq K < R$, peace is the only equilibrium under strategic deployment, whereas it is one of two possible equilibria under full deployment.

Strategic deployment clearly performs better than full deployment, in terms of reducing the scale of warfare, as measured by $G_1 + G_2$. But there are many possible ROEs, and it is impossible to compare strategic deployment to each in turn. The following proposition, however, establishes that none can perform better than strategic deployment as it has been defined here.

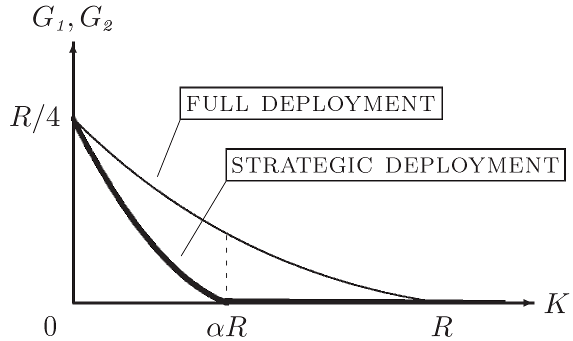

FIGURE 3. Equilibria under strategic deployment. For $0 < K < \alpha R$, strategic deployment performs better than full deployment. When $K \geq \alpha R$, peace is the unique equilibrium.

Proposition 2. *In all equilibria, $G_1 + G_2 \geq 2M$. In other words, strategic deployment is the ROE which minimizes $G_1 + G_2$.*

Proof. See appendix.

Strategic deployment, then, would certainly suit peacekeepers. There remains to see if the adversaries in the conflict would appreciate this sort of intervention. The next result shows that they would.

Proposition 3. *In all equilibria, $\pi_1 + \pi_2 \leq R - 2M$. In other words, strategic deployment is the ROE which maximizes combined warlord payoffs.*

Proof. See appendix.

The intuition behind this result is rather simple. Conflict (a form of rent-seeking) is an activity where individual optimization does *not* lead to a socially efficient outcome. There are significant negative externalities. By inducing warlords to commit fewer resources to fighting, peacekeepers allow them to consume more.

3 Conclusion

Clearly this model does not contain everything that must be considered when mounting a peacekeeping initiative. Though it unfolds in stages, it does not take into account the full dynamics of conflict (initiation, escalation, and so on). Its protagonists are perfectly informed and make cold, calculated decisions.

The model's main goal is to highlight the importance of the threat value of peacekeeping forces. If peacekeepers make their deployment decisions based on the levels of armament on both sides of a conflict — and if both sides know this — then they (the peacekeepers) can influence the scale of fighting in the right direction. If not, then their influence is minimized, and an opportunity is wasted.

In this instance the threat of force is more powerful than force itself. By *threatening* to use its full force K, rather than deploying it outright, the third party manages to reduce the scale of conflict $(G_1 + G_2)$. And in equilibrium, since the warlords comply with the limits set by the third party, peacekeepers do not even have to participate in the conflict $(G^P = 0)$.

This model somewhat parallels Blouin and Pallage (2008) [BP for short], a paper on the delivery of humanitarian aid to areas undergoing civil conflict. In BP, the analog of an ROE is a delivery plan for the aid which needs to be delivered: so much through one warlord's area, so much through the other's, depending on the sizes of their armies. Underdog deployment has its counterpart in BP, as does strategic deployment, the optimal plan. These similarities are neither contrived nor coincidental. Both aid and peacekeeping are forms of third-party intervention. Aid, much of which is looted along the way to its intended recipients, acts as a transfer to one side or the other in a conflict. Its delivery through one area affects all those within, including the warlord and his militia. Changing an aid delivery plan will be felt as a gain by some and as a loss by others. The issue is substantial, since aid constitutes a large fraction of some countries' income, and the fraction that is looted by militias is rather staggering. Somalia has been a case in point.

Peacekeeping, depending on its mode of deployment, also has its carrot-and-stick properties. No warlord, if thinking rationally, wants an extra adversary. But he would welcome an ally. A peacekeeping force, because it can act as ally or adversary to either side in a conflict, can have a large impact on the outcome, not through actual fighting, but by making very clear how and under what circumstances it will fight.

Adopting strategic deployment (or anything close to it) as a guiding principle would require a complete change of attitude on the part of the United Nations. The UN Department of Peacekeeping Operations currently operates on the basis of three broad principles, outlined in a document commonly known as the Capstone Doctrine (United Nations, 2005). First, consent of the parties involved in the conflict is required if any intervention is to take place. Second, impartiality is to be maintained throughout the peacekeeping operation. Third, peacekeepers are not allowed to use force except in self-defence and defence of the mandate. In terms of the model in this paper, the second principle means $G_1^P = G_2^P = 0$, and the first principle probably means $G_3^P = 0$ as well. Thus any kind of intervention such as what is considered here would not be approved.

But the UN seems willing to put aside these principles under some circumstances. Gareth Evans points out that in the 1990s alone there were nine third-party interventions in state conflicts which were both humanitarian and coercive. Most either involved UN troops or operated with the approval of the UN Security Council (Evans, 2008).

Evans was one of the co-founders of the International Commission on Intervention and State Sovereignty (ICISS), which spearheaded the *Responsibility to Protect* (or R2P) initiative in its 2001 report. A few years later, R2P was one of the central themes of the UN's 2005 *World Summit Outcome*. It also has three principles. First, states must protect their own populations from mass atrocities. Second, the international community has a responsibility to help states do this. And third, if states fail to do this, the international community should intervene through coercive measures such as economic sanctions and (as a last resort) military involvement.

It is precisely when one side in a conflict significantly outnumbers the other ($G_1 > G_2$) and mobilizes a substantial force ($G_1 > M$) that mass atrocities are likely to take place. And it is in those instances that strategic deployment prescribes military intervention. So there is definite congruity between the model's prescriptions and the goals of R2P.

Appendix

A. Proof of Proposition 1

For simplicity I deal only with pure strategies in this proof. The proof can be generalized to mixed strategies as well. Assume throughout that the ROE is given by equations (11) and (12).

The function π_1 has a discontinuity at $G_1 = \max\{G_2, M\}$ and an endpoint at $G_1 = 0$, but everywhere else it is continuous and concave. So any equilibrium in which $0 < G_1 \neq \max\{G_2, M\}$ requires that the first-order condition $\partial\pi_1/\partial G_1 = 0$ be satisfied, to ensure that warlord 1 cannot increase his payoff by making a slight change to G_1 in either direction. And of course, any equilibrium requires that warlord 1 be unable to increase his payoff by changing G_1 to any other level, such as M or a level slightly below G_2. Naturally the foregoing also applies to G_2.

First, suppose $G_1 = 0 < M$. Warlord 2 can secure the entire prize at almost no cost, by setting G_2 slightly above 0. Warlord 1 ends up with a zero payoff, although he could get a positive payoff by arming himself. This cannot happen in equilibrium. It follows that G_1 cannot be zero in equilibrium if M is positive.

Now suppose that $0 < G_1 < G_2 \leq M$ or that $0 < G_1 = G_2 < M$. In either case, routine calculations show that the derivative $\partial\pi_1/\partial G_1$ is necessarily positive. Yet it has to be zero for equilibrium to hold.

Next, suppose that $G_1 > \max\{G_2, M\}$ and that $G_2 > 0$. All peacekeepers fight for side 2. This situation requires that both first-order conditions $\partial\pi_1/\partial G_1 = 0$ and $\partial\pi_2/\partial G_2 = 0$ be met. Solving these conditions yields $G_1 = R/4$ and $G_2 = (R/4) - K$. Warlord 1 obtains a payoff of $\pi_1 = R/4$, which he can improve upon by setting G_1 just below G_2 if $G_2 > M$ (making all peacekeepers fight for him) or by setting $G_1 = M$ if $G_2 \leq M$ (making peacekeepers stay out of the fight). So the situation cannot be an equilibrium.

Finally suppose that $G_1 = G_2 > M$. In this case peacekeepers take no action. Warlord 1's payoff is $(R/2) - G_1$. He can get more than this by lowering G_1 slightly, making all peacekeepers fight on his side. Hence this cannot be an equilibrium.

Naturally the same arguments go through if we reverse warlords 1 and 2. That exhausts all possibilities except $G_1 = G_2 = M$. □

B. Proof of Proposition 2

For simplicity we deal only with pure strategies in this proof. The proof can be generalized to mixed strategies as well.

Consider an equilibrium where warlords' forces are G_1^* and G_2^* and where the third party applies a certain ROE — call it ROE*. Let π_1^* denote warlord 1's payoff in this equilibrium and let π_2^* denote warlord 2's. Now what would happen if warlord 1 deviated from this equilibrium? Specifically, what would happen if warlord 2 played G_2^* but warlord 1 played $\tilde{G}_1 \equiv \sqrt{R(G_2^* + K)} - G_2^* - K$ instead of G_1^* (and the third party applied ROE* as before)? Warlord 1's payoff (which I will call $\tilde{\pi}_1$) would be

$$\tilde{\pi}_1 \quad = \quad \left[\frac{\tilde{G}_1 + \tilde{G}_1^P}{\tilde{G}_1 + G_2^* + \tilde{G}^P}\right] R \quad - \quad \tilde{G}_1 \quad ; \tag{15}$$

where $\tilde{G}_1^P$ and $\tilde{G}^P$ are the third party's responses (under ROE*) to $\tilde{G}_1$ and G_2^*. Because $\tilde{G}_1^P \geq 0$ and $\tilde{G}^P \leq K$, we have

$$\tilde{\pi}_1 \quad \geq \quad \left[\frac{\tilde{G}_1}{\tilde{G}_1 + G_2^* + K}\right] R \quad - \quad \tilde{G}_1 \quad . \tag{16}$$

Substituting the definition of $\tilde{G}_1$ into (16), we get

$$\tilde{\pi}_1 \quad \geq \quad R + K + G_2^* - 2\sqrt{R(G_2^* + K)} \quad . \tag{17}$$

Whatever the value of $\tilde{\pi}_1$, it cannot be greater than π_1^*, because π_1^* is the equilibrium payoff, i.e. the highest payoff that warlord 1 can achieve when warlord 2 plays G_2^* and the peacekeepers apply ROE*. So $\pi_1^* \geq \tilde{\pi}_1$, and as a result

$$\pi_1^* \quad \geq \quad R + K + G_2^* - 2\sqrt{R(G_2^* + K)} \quad . \tag{18}$$

Repeating this exercise for warlord 2 yields

$$\pi_2^* \quad \geq \quad R + K + G_1^* - 2\sqrt{R(G_1^* + K)} \quad . \tag{19}$$

Adding (18) and (19) together gives us

$$\pi^* \quad \geq \quad 2R + 2K + G^* - 2\left[\sqrt{R(G_1^* + K)} + \sqrt{R(G_2^* + K)}\,\right] \quad , \tag{20}$$

where $\pi^* \equiv \pi_1^* + \pi_2^*$ and $G^* \equiv G_1^* + G_2^*$. The quantity in brackets is no greater than $\sqrt{2R(G^* + 2K)}$, since for any numbers a and b the inequality $\sqrt{a} + \sqrt{b} \leq \sqrt{2(a+b)}$ must hold; this is a standard result from geometry, and an example of the Cauchy-Schwarz inequality. Also, total payoff π^* can be no greater than $R - G^*$, the value of the prize less military expenditures. These two observations allow us to write

$$R - G^* \quad \geq \quad \pi^* \quad \geq \quad 2R + 2K + G^* - 2\sqrt{2R(G^* + 2K)} \quad , \tag{21}$$

from which it is fairly straightforward to show

$$G^* \quad \geq \quad \frac{R - 2K - 2\sqrt{2KR}}{2} \quad = \quad 2M \quad . \tag{22}$$

This completes the proof. □

C. Proof of Proposition 3

By definition we have

$$\pi_1 + \pi_2 \quad = \quad \left[\frac{G_1 + G_2 + G_1^P + G_2^P}{G_1 + G_2 + G_1^P + G_2^P + G_3^P} \right] R - (G_1 + G_2) \quad . \tag{23}$$

The fraction in brackets is no greater than 1. The term in parentheses is at least $2M$, by Proposition 2. Therefore the entire right-hand side of (23) is no greater than $R - 2M$. □

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